Worksheet 4 Thinking logically Answers

Task 1

1. Use the trace table below to help you answer (a), (b) and (c) below.
   What would be the values of integer variables x, y and z after execution of these statements if the initial values of x and y are

   (a) 2 and 7 2 200 47

   (b) -4 and -4 16 6 -4

   (c) 27 and 3 27 200 9

```
z = x
IF x = y THEN
        x = x * x
        y = (x + y) / 2
    ELSE
        IF x < y THEN
            y = y * y
            z = y - x
        ELSE
            IF x > 0 THEN
                z = x/y
            ENDIF
        ENDIF
        y = 200
    ENDIF
    OUTPUT x, y, z
```

Trace

x	y	z
2	7	2
	49	47
	200	
-4	-4	-4
16	6	-4
27	3	27
		9
	200	

2. Use a trace table to determine the output from the following algorithm.

```
x = 5
k = 10
sum = 45
WHILE sum < 75
    sum = sum + k
    OUTPUT k
    k = k + x
ENDWHILE
OUTPUT sum
```

x	k	sum	OUTPUT
5	10	45	
		55	10
	15	70	15
	20	90	20
	25		90

See Python and VB programs Worksheet 4 trace tables

3. Study the following algorithm and fill in the trace tables below to discover what it does.

```
y = 2
z = 1
OUTPUT ("Please enter a positive integer: ")
x = USERINPUT
WHILE z<>0
     z = x mod y
      IF z <> 0 THEN
          y = y + 1
      ENDIF
ENDWHILE
IF x = y
   print (x, " is in category 1")
ELSE
   print (x, " is in category 2")
ENDIF
```

x	y	z
25	2	1
	3	1
	4	1
	5	1
		0

x	y	z
7	2	1
	3	1
	4	1
	5	3
	6	2
	7	1
		0

(i) If the user inputs the integer 25, what is output? OUTPUT: 25 is in category 2

(ii) If the user enters the integer 7, what is output? OUTPUT: 7 is in category 1

(iii) What are “category 1” and “category 2”? What is the purpose of the program?

The program tests if the number input is a prime number. “Category 1” is prime, “category 2 is non-prime.

(iv) Suggest ways in which the program could be made easier to understand.

The program would be easier to understand if comments were added to explain the purpose of the program and the way it works. Instead of “category 1” and

"category 2" the output should say, "This is a prime number" or "This is not a prime number".

Meaningful variable names would also help – y is *divisor*, x mod y could be put in a variable called *remainder*.

(v) This is a "brute force" algorithm. Suggest how the algorithm could be made more efficient.

Once you have found that the number is not divisible by 2, there is no point testing for other even numbers. Likewise, once you have tested for any other number like 3, 5, etc there is no point testing for multiples of that number.

See programs Worksheet 4 primes.py and Worksheet 4 primes.vb

Task 2

4. Sean has written a program which contains a complex Boolean expression controlling a while loop.

(a) Complete the truth table for the Boolean expression:

```
while ((a > b) or (b > c)) and ((not (a > b)) and (not (b > c)))
```

Let P represent a > b and Q represent b > c

P	Q	not P	not Q	P or Q	Not P and not Q	(P or Q) and (not P and not Q)
False	False	True	True	False	True	False
False	True	True	False	True	False	False
True	False	False	True	True	False	False
True	False	False	False	True	False	False

(b) How many times will this loop be performed if a = 1, b = 2, c = 3? 0

How did you calculate your answer? Substitute in the numbers to evaluate the expression.

5. The programmer decides that the condition is not correct. He tries again.

```
while (a > b or b > c) or (not (a > b) and not (b > c))
```

Complete the truth table for this loop.

P	Q	not P	not Q	P or Q	Not P and not Q	(P or Q) or (not P and not Q)
False	False	True	True	False	True	True

False	True	True	False	True	False	True
True	False	False	True	True	False	True
True	False	False	False	True	False	True

How many times will this loop be performed if a = 1, b = 2, c = 3? 1

Task 3

6. An Internet site has the following login procedure. To access their account, a customer has to enter

   - a 10-character user ID (3 attempts allowed)
   - a 4-digit PIN (1 attempt allowed)
   - three random characters from their password (3 attempts allowed)

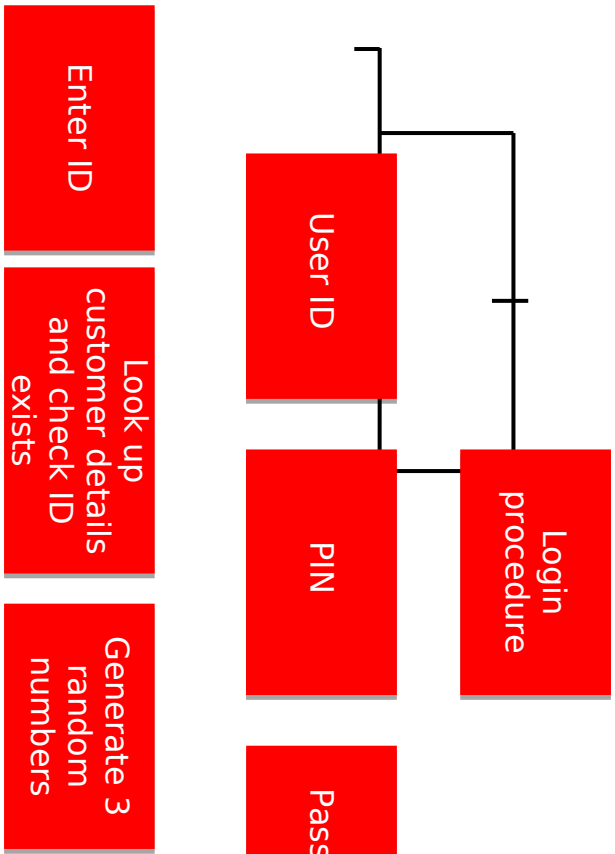
   Once the user enters their user ID, a subroutine is called which looks up their record and reads the stored userID, PIN and password.

   If the user fails after 3 attempts to enter an ID which is held in the record, a message is displayed “Incorrect ID – access denied”

   Similar messages are displayed if the user fails to enter a correct PIN or password

   If all details are correct, access to the account is permitted.

   (a) Draw a hierarchy chart to show the tasks and subtasks involved in the login procedure.



Verify password characters

Stud come up with many variations on this, which may well be correct – the main thing to remember is that a hierarchy chart does not show the detail involved in any of the routines. It just shows the tasks and subtasks.

(b) Write pseudocode for a subroutine to check that the user ID exists on a customer file.

```
function userIDEntry
    attempts = 0
    validID = False
    output “Please enter ID”
    while validID == False AND attempts < 3
        userID  = input()
        read (CUSTOMER file, userID)
        if userID exists then
            validID = True
        else
            attempts = attempts + 1
            output “Invalid ID – please re-enter”
        endif
    endwhile
    return validID
endfunction
```

(c) What are the weaknesses in this login procedure? What improvements would you suggest?

Ease of use:

The user should be offered some way of retrieving a forgotten user ID.

There could be a “Remember user ID” option so that they don’t have to enter details each time

Security:

If the user ID, PIN and password are stored on a file in unencrypted form, it would be easy for someone to hack in and find them out. They should be stored in encrypted form and the encryption algorithm also applied to whatever the user enters, so the two can be compared.

Task 4

7. Look up “Benefits of quad-core processor” in a search engine and list some of the benefits and applications which commonly use parallel processing.

These are two possible sites – there are many.

http://uk.pcmag.com/laptops/62327/feature/comparing-dual-core-vs-quad-core-cpus

http://www.nvidia.co.uk/content/PDF/tegra_white_papers/tegra-whitepaper-0911a.pdf